

CLAIMS

What is claimed is:

1. An electric motor having an armature, the electric motor comprising:

a lamination stack forming the armature, and having a plurality of radially extending, spaced apart posts, said posts forming a plurality of slots therebetween;

a first coil having first and second subcoil portions, said first subcoil portion being wound in a first pair of said slots, and said second subcoil portion being wound in a second pair of said slots that are offset from said first pair of slots;

a second coil having a first subcoil portion wound in said second pair of said slots, and a second subcoil portion wound in a third pair of said slots offset from said second pair of slots;

a third coil having first and second subcoil portions wound in the same slots as said subcoil portions of said second coil; and

a plurality of additional coils wound in said slots such that a winding pattern defined by said subcoil portions of said first, second and third coils is repeated.

2. The electric motor of Claim 1, wherein said first and second subcoil portions of said first coil comprise different pluralities of windings.

3. The electric motor of Claim 1, wherein one of said first and second subcoil portions of said first coil has approximately three times as many winding turns as the other.

4. The electric motor of Claim 1, wherein said third pair of slots is offset from said second pair of slots by one slot position.

5. The electric motor of Claim 1, wherein said second pair of slots is offset by one slot position from said first pair of slots.

6. An electric motor having an armature, the electric motor comprising:

a lamination stack forming the armature, the lamination stack having a plurality of radially extending, spaced apart posts, said posts forming a plurality of winding slots therebetween;

a first coil having first and second subcoil portions, said first subcoil portion being wound in a first pair of said slots and said second subcoil portion being wound in a second pair of said slots that are offset from said first pair of said slots;

a second coil having first and second subcoil portions with said first subcoil portion thereof being wound in a third pair of slots that are offset from said first pair of slots, and said second subcoil portion of said second coil being wound in a fourth pair of slots;

a third coil having first and second subcoil portions that are wound in the same pair of said slots as said subcoil portions of said second coil; and

an additional plurality of coils wound such that a winding pattern defined by said first, second and third coils is repeated.

7. The electric motor of claim 6, wherein said fourth pair of slots is offset by one slot position from said second pair of slots.

8. The electric motor of Claim 6, wherein said third pair of said slots and said second pair of said slots comprise the same pair of said slots.

9. The electric motor of Claim 6, wherein said first and second subcoil portions of said first coil have different pluralities of winding turns.

10. The electric motor of Claim 6, wherein said first subcoil portion of said second coil has a different plurality of winding turns than said second subcoil portion of said first coil.

11. The electric motor of Claim 10, wherein said second subcoil portion of said first coil is wound in the same pair of said slots as said first subcoil portion of said second coil.

12. The electric motor of Claim 6, wherein said second pair of slots is offset by one slot position from said first pair of slots.

13. The electric motor of claim 6, wherein said first and second subcoil portions of said first coil have pluralities of winding turns that differ such that one has approximately three times a number of winding turns as the other.

14. An electric motor comprising:

an armature having a plurality of spaced-apart posts defining a plurality of winding slots therebetween;

a stator disposed coaxially with the armature, said stator having a plurality of spaced apart field coils defining a magnetic neutral zone between each adjacent pair of said field coils;

a coil having a first subcoil portion and a second subcoil portion;

said first subcoil portion having a first plurality of winding turns and being wound in a first pair of spaced apart ones of said slots that are advanced, relative to a given one of said field coils, during rotation of said armature;

said second subcoil portion having a second plurality of winding turns and being wound in a second pair of spaced apart ones of said slots that are offset from said first pair of spaced apart slots, and retarded, relative to said given field coil, during rotation of said armature;

a second coil having first and second subcoil portions wound in third and fourth pairs, respectively, of spaced apart ones of said slots;

wherein a magnetic axis of said first coil is advanced, relative to said given field coil, when said first coil is excited;

wherein a magnetic axis of said second coil is retarded, relative to said given field coil, when said second coil is excited; and

wherein both of said coils at least substantially complete commutation within a spaced apart pair of said magnetic neutral zones when said coils are excited.

15. The electric motor of claim 14, wherein said first plurality of winding turns differs from said second plurality of winding turns in number.

16. The electric motor of claim 14, wherein one of said first and second pluralities of winding turns has approximately three times a number of winding turns as the other.

17. A two coil-per-slot electric motor comprising:
an armature having a plurality of spaced-apart posts defining a plurality of winding slots therebetween;

a commutator having a plurality of commutator bars that number twice that of said winding slots;

a stator disposed coaxially with the armature, said stator having a plurality of spaced apart field coils defining a magnetic neutral zone between each adjacent pair of said field coils;

a first coil having a first subcoil portion and a second subcoil portion;

said first subcoil portion being wound in a first pair of spaced apart ones of said slots;

said second subcoil portion being wound in a second pair of spaced apart ones of said slots that are offset from said first pair of spaced apart slots;

a second coil having a first subcoil portion and a second subcoil portion;

said first subcoil portion of said second coil being wound in said

second pair of spaced apart slots so as to overlap said second subcoil portion of said first coil;

said second subcoil portion of said second coil being wound in a third pair of spaced apart ones of said slots offset from said second pair of spaced apart slots;

wherein a magnetic axis of said first coil is advanced, relative to a given said field coil, when said first coil is excited;

wherein a magnetic axis of said second coil is retarded, relative to said given field coil, when said second coil is excited;

wherein both of said coils at least substantially complete commutation when each said coil is excited within a spaced apart pair of said magnetic neutral zones such that substantially no commutation of either of said coils occurs outside of any of said magnetic neutral zones.

18. The electric motor of claim 17, wherein said first and second subcoil portions of said first coil have differing pluralities of winding turns.

19. The electric motor of claim 17, wherein one of said first and second subcoil portions of said first coil has approximately three times a number of winding turns as the other.

20. The electric motor of claim 17, further comprising a third coil having first and second subcoil portions that are wound in the same said slots as said subcoil portions of said second coil.

21. An electric motor comprising:

an armature having a plurality of spaced apart posts defining a plurality of spaced apart winding slots therebetween;

a first coil having first and second subcoil portions coupled in series;

a second coil having first and second subcoil portions coupled in series;

a third coil having first and second subcoil portions coupled in series;

said subcoil portions of said first coil being wound in first and second spaced apart pairs of said slots;

said subcoil portions of said second coil being wound in a third and fourth spaced apart pairs of said slots, wherein said third pair of spaced apart slots is offset by at least one slot position from said first pair of spaced apart slots;

said subcoil portions of said third coil being wound in said third and fourth slots so as to overlap said first and second subcoil portions of said second coil; and

an additional plurality of coils wound on said armature, with each one of said additional plurality of coils being segmented into first and second subcoil portions, and further wound such that a winding pattern defined by windings of said first, second and third coils is repeated.

22. The electric motor of claim 21, further comprising a commutator having a plurality of commutator segments that is twice that in number of said plurality of winding slots.

23. An electric motor having an armature, the electric motor comprising:

a lamination stack having a plurality of radially extending posts, said posts forming a plurality of slots therebetween, said slots being arranged in a circumferential pattern;

a plurality of coils wound around said slots, said coils being arranged in pairs about said lamination stack;

each said coil being divided into first and second subcoil portions, with said first subcoil portion having a first plurality of winding turns and said second subcoil portion having a second plurality of winding turns, and wherein said first and second subcoil portions are wound in different, circumferentially offset pairs of said slots and coupled to designated pairs of commutator segments of a commutator;

wherein a first pair of said coils are wound in an overlapping fashion such that the first subcoil portion of a second one of said first pair of coils is wound in the same slots as said second subcoil portion of a first one of said first pair of coils, and said second subcoil portion of said

second one of said first pair of coils is wound in a pair of slots offset by one slot position from said slots that said second subcoil portion of said first one of said first pair of coils is wound in; and

wherein a second pair of coils circumferentially offset from said first pair of coils is further wound such that a first subcoil portion of a first one of said second pair of coils is wound in the same slots as said first subcoil portion of said second coil of said first pair of coils, and said second subcoil portion of said first one of said second one of second pair of coils is wound in the same slots as said second subcoil portion of said second coil of said first pair of coils.

24. The electric motor of claim 23, wherein one of said first and second subcoil portions of each said coil has a greater number of winding turns than the other of said subcoil portions.

25. The electric motor of claim 23, wherein one of said first and second subcoil portions of each said coil has approximately three times the number of winding turns as the other of said subcoil portions.

26. An electric, rotating machine comprising:

a stator having a plurality of field coils, wherein said field coils are spaced apart to form gaps therebetween, said gaps representing magnetic neutral zones;

an armature having a plurality of coils wound thereon; and

wherein said coils are wound such that each said coil begins, and at least substantially completes, commutation while said coil passes through one of said magnetic neutral zones.

27. The machine of claim 26, wherein said coils are wound such that each said coil begins and completes commutation within one of said magnetic neutral zones, such that no commutation of any of said coils occurs outside of said magnetic neutral zones.

28. The machine of claim 26, wherein each said coil is segmented into two subcoil portions coupled in series.

29. The machine of claim 28, wherein said subcoil portions of first and second ones of said coils are wound such that said subcoil portions of each partially overlap.

30. An electric motor, comprising:

a stator having a plurality of field windings spaced apart around said stator, and defining magnetic neutral zones therebetween;

an armature having a plurality of coils wound thereon in accordance with a winding pattern defining a greater than one coil per slot construction;

wherein first ones of said coils are wound so as to have their magnetic axes advanced, relative to given ones of said field coils, during rotation of said armature;

wherein second ones of said coils are wound so as to have their magnetic axes retarded, relative to given ones of said field coils, during rotation of said armature; and

wherein said coils are further arranged so as to begin and at least substantially complete commutation within said magnetic neutral zones.